Proposed Interview Agenda with Proposed Amendments and Remarks - DO NOT ENTER

/RWH/

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If transmission is unclear, please telephone (303) 499-8080 immediately and ask for Bobbye.

Thank you for agreeing to discuss this case in a telephone interview on Monday, June 8, 2009 at 2 pm Eastern time (noon Mountain time). Stephen Barone, also of Greenlee, Winner and Sullivan, plans to join the call, if possible. Enclosed for your review is a draft response to the final Office Action.

Please contact us if you have any questions.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/829,598 Confirmation No.: 6855
Applicant : Graetz et al.
Filed : April 22, 2004
TC/A.U. : 1795
Examiner : Hodge, Robert W.
For : High-Capacity Nanostructured Germanium-Containing Materials and Lithium Alloys Thereof
Docket No. : 27-06
Customer No.: 23713

CERTIFICATE OF EFS-WEB FILING

I hereby certify that this correspondence is being filed using the USPTO EFS-WEB system.

Date Tamala R. Jonas

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AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

Sir:

In response to the Office Action mailed December 17, 2008, please amend the above-identified application as follows.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 9 of this paper.

Amendments to the Claims:

This listing will replace all prior versions, and listings, of claims in the application.

Listing of the Claims.

1. (currently amended) An electrode for a secondary electrochemical cell comprising a substrate and a nanostructured material of a silicon-germanium alloy of formula $Si_{(1-z)}Ge_z$ or a alkali metal alloy of said silicon-germanium alloy, wherein z is from 0.25 to 0.75 and the nanostructured material is in the form of a single layer.

2. (original) The electrode of claim 1, wherein the alkali metal alloy is a lithium alloy.

3. (currently amended)The electrode of claim 1 wherein the nanostructured material ~~comprises~~ is in the form of nanoparticles.

4. (original)The electrode of claim 3, wherein the nanoparticles [has] have a diameter of not greater than about 300 nm.

5. (original)The electrode of claim 4, wherein the nanoparticles [has] have a diameter of not greater than about 100 nm.

6. (original)The electrode of claim 5, wherein the nanoparticles [has] have a diameter of not greater than about 50 nm.

7. (original)The electrode of claim 1, wherein the nanostructured material is a nanofilm.

8. (original)The electrode of claim 7, wherein the nanofilm has a thickness of not greater than about 500 nm.

9. (original)The electrode of claim 8, wherein the nanofilm has a thickness of not greater than about 200 nm.

10. (original)The electrode of claim 9, wherein the nanofilm has a thickness of not greater than about 100 nm.

11. (original)The electrode of claim 2, wherein the lithium alloy of the nanostructured material has the formula $Li_xSi_{(1-z)}Ge_z$, wherein x is at least about 1.

12. (original)The electrode of claim 11, wherein the lithium alloy of the nanostructured material has the formula $Li_xSi_{(1-z)}Ge_z$, wherein x is at least about 2.5.

13. (original)The electrode of claim 1, wherein the nanostructured material has a cycle life that is stable over at least about 10 cycles.

14. (original)The electrode of claim 13, wherein the nanostructured material has a cycle life that is stable over at least about 20 cycles.

15. (original)The electrode of claim 1, wherein the nanostructured material exhibits a rate capability of at least about 1*C*.

16. (original) The electrode of claim 1, further comprising a binder and/or adhesive .

17. (currently amended)The electrode of claim 1, ~~further comprising a substrate~~ wherein the layer of nanostructured material adheres to the substrate .

18. (currently amended)The electrode of claim [17]1, wherein the substrate is a current collector and comprises a metal.

19. (withdrawn)A secondary electrochemical cell comprising an anode, a cathode, and an electrolyte, wherein the anode comprises nanostructured material of formula $Si_{(1-z)}Ge_z$ or a lithium alloy thereof, wherein $0 < z \leq 1$.

20. (withdrawn)The secondary electrochemical cell of claim 19, wherein the secondary electrochemical cell is an electrochemical supercapacitor.

21. (withdrawn)The secondary electrochemical cell of claim 19, wherein the secondary electrochemical cell is fabricated on an integrated device.

22-29 (cancelled)

30. (canceled) ~~An electrode for a secondary electrochemical cell comprising a of germanium or a germanium alkali metal alloy, wherein said nanofilm has a thickness not greater than about 500 nm~~.

31. (canceled)~~The electrode of claim 30, wherein the thickness of the nanofilm is not greater than about 200 nm~~.

32. (canceled) ~~The electrode of claim 30, wherein the thickness of the nanofilm is not greater than about 100 nm~~.

33. (canceled) ~~The electrode of claim 30, wherein the alkali metal alloy is a lithium alloy~~.

34. (canceled) ~~The electrode of claim 30, wherein the electrode comprises a contiguous germanium nanofilm~~.

35. (canceled) ~~The electrode of claim 30, wherein the electrode comprises a germanium alkali metal alloy produced by electrochemically alloying an alkali metal with a contiguous germanium nanofilm~~.

36. (canceled) ~~The electrode of claim 30, wherein the electrode further comprises a conductive diluent~~.

37. (canceled) ~~The electrode of claim 36, further comprising a current collector.~~

38. (canceled) ~~The electrode of claim 36, wherein the electrode comprises alternating layers of germanium nanofilms and said conductive diluent~~.

39. (canceled) ~~The electrode of claim 36, wherein the conductive diluent is capable of binding or alloying with an alkali metal~~.

40. (canceled) ~~The electrode of claim 39, wherein the alkali metal is lithium~~.

41. (currently amended) An electrode for a secondary electrochemical cell comprising a nanofilm of nanostructured material of formula $Si_{(1-z)}Ge_z$ wherein $0 < z \leq 1$, the nanofilm being a continuous film which is not in the form of an aggregate of nanoparticles wherein the nanofilm is amorphous.

42. (currently amended) An electrode for a secondary electrochemical cell comprising an alkali metal alloy of nanostructured material of formula $Si_{(1-z)}Ge_z$ wherein $0 < z \leq 1$ and the alkali metal alloy is produced by electrochemically alloying an alkali metal with a nanofilm of the nanostructured material, the nanofilm not being in the form of an aggregate of nanoparticles and being continuous prior to electrochemical alloying with the alkali metal, wherein the nanofilm is amorphous prior to electrochemical alloying with the alkali metal .

43. (currently amended). The electrode of claim 1, wherein the electrode further comprises a conductive diluent and <u>the conductive diluent is a metal or conductive carbonaceous material</u>.

44. (previously presented) The electrode of claim 43, wherein the conductive diluent is capable of binding or alloying with an alkali metal.

45. (previously presented) The electrode of claim 44, wherein the alkali metal is lithium.

46. (currently amended) An electrode for a secondary electrochemical cell comprising nanostructured material and a conductive diluent, wherein the nanostructured material comprises [a] germanium or germanium alkali metal alloy nanoparticles <u>and the conductive diluent is a metal or conductive carbonaceous material</u>.

47. (previously presented) The electrode of claim 46, further comprising a current collector.

48. (previously presented) The electrode of claim 46, wherein the electrode comprises alternating layers of germanium nanoparticles and conductive diluent.

49. (previously presented) The electrode of claim 46, wherein the conductive diluent is capable of binding or alloying with an alkali metal.

50. (previously presented) The electrode of claim 49, wherein the alkali metal is lithium.

51. (currently amended) The electrode of claim 1, wherein z is greater than 0.5 <u>and less than or equal to 0.75</u>.

52. (Previously presented) The electrode of claim 41, wherein the nanofilm adheres to a substrate which serves as a current collector.

53. (previously presented) The electrode of claim 41, wherein the electrode comprises alternating layers of a nanofilm of nanostructured material of formula $Si_{(1-z)}Ge_z$ and a metal film.

54. (Previously presented) The electrode of claim 41, where the thickness of the nanofilm is no greater than 500 nm.

55. (canceled) ~~The electrode of claim 41, wherein the nanofilm is amorphous~~.

56. (Previously presented) The electrode of claim 41, wherein the nanofilm is a Ge-Si alloy.

57. (Previously presented) The electrode of claim 42, wherein the nanofilm adheres to a substrate which serves as a current collector.

58. (Previously presented) The electrode of claim 42 wherein the electrode comprises alternating layers of an alkali metal alloy of nanostructured material of formula $Si_{(1-z)}Ge_z$ and a metal film.

59. (Previously presented) The electrode of claim 42 wherein the alkali metal is lithium.

60. (Previously presented) The electrode of claim 42, where the thickness of the nanofilm is no greater than 500 nm.

61. (canceled) ~~The electrode of claim 42, wherein the nanofilm is amorphous prior to electrochemical alloying with the alkali metal~~.

62. (Previously presented) The electrode of claim 42, wherein the nanofilm is a Ge-Si alloy.

63. (new) The electrode of claim 7 wherein the nanofilm is not in the form of an aggregate of nanoparticles.

64. (new) The electrode of claim 63 wherein the nanofilm is an amorphous silicon-germanium alloy nanofilm.

65. (new) The electrode of claim 1 wherein the nanostructured material is an alkali metal alloy of an amorphous silicon-germanium alloy nanofilm, the nanofilm not being in the form of an aggregate of nanoparticles.

REMARKS

Prior to entry of this amendment claims 1-21 and 30-62 are pending in the application, with claims 19-21 being withdrawn from consideration. This amendment cancels claims 30-40, 55 and 61 and adds new claims 63-65.

The Amendments to the Claims

Claim 1 has been amended to recite that the electrode comprises a substrate and that the nanostructured material is in the form of a single layer. This amendment is supported at by Fig. 3A and 3B and by the description in Examples 1 and 2. Applicants note that this limitation does not exclude the electrode configurations shown in Figs. 3C, and 3D, in which the substrate (and layer of nanostructure material) may be folded or rolled.

Claim 3 had been amended to recite that the nanostructured material is in the form of nanoparticles. This amendment is supported at page 11, paras. 49.

Claims 4-6 have been amended for consistency with amended claim 3.

Claim 17 has been amended to recite that the layer of nanostructured material adheres to the substrate. This amendment is supported at page 15, para. 59.

Claim 18 has been amended to depend from claim 1, rather than claim 17, and specifies that the substrate comprises a metal. This amendment is supported at page 15, para. 60.

Please cancel claims 30-40 without prejudice.

Claims 41 has been amended to recite that the nanofilm is amorphous. This amendment is supported at page 14, para. 57,

Claim 42 has been amended to recite that the nanofilm is amorphous prior to electrochemical alloying with the alkali metal. This amendment is supported at page 14, para. 57 and at page 20, para. 77, which describes formation of Li-Ge crystalline phase.

Claims 43 and 46 have been amended to recite that the conductive diluent is a metal or conductive carbonaceous material. This amendment is supported at page 16, para. 61.

Claim 51 has been amended to add the limitation that z is less than or equal to 0.75. This upper bound is placed by the composition range in claim 1.

Claims 55 and 61 have been deleted in view of the amendments to claims 41 and 42.

Claim 63 depends from claim 7 and specifies that the nanofilm is not in the form of an aggregate of nanoparticles. Support for this limitation is found in Example 4 (para. 73), the bright field transmission electron microscope image of Figure 5A and other locations in the application as filed.

Claim 64 depends from claim 63 and specifies that the nanofilm is an amorphous Si-Ge alloy. These limitations are supported at page 14, para. 57, page 10, paras. 46-47 and Example 9.

Claim 65 depends from claim 1 and specifies that the nanostructured material is an alkali metal alloy of an amorphous silicon-germanium alloy nanofilm, the nanofilm not being in the form of an aggregate of nanoparticles. This claim is supported at page 14 para. 57, page 10, paras. 46-47, page 3, para. 14 and Examples 4 and 9.

The Rejection Under 35 U.S.C. 112

Claim 51 was rejected under 35 U.S.C. 112 as being indefinite. Claim 51 has been amended to clarify that the upper limit of the germanium concentration is as set out in claim 1, from which claim 51 depends. The rejection is believed to be obviated by the amendment to claim 51. Reconsideration and withdrawal of the rejection is respectfully requested.

The Rejections Under 35 U.S.C. 102(b)

Saitoh et al.

Claims 1-18, 30-41 and 43-56 are rejected under 35 U.S.C, 102(a)/(e) as being anticipated by U.S. Pre-Grant Publication No. 2003/0165697 to Saitoh et al. (hereinafter Saitoh). Applicants note that claims 30-40 have been canceled.

At page 2, paras. 9 and 14 Saitoh discloses a $Si_{1-x-y}Ge_xC_w$ semiconductor crystal including more two or more alternately stacked sets of an $Si_{1-z}Ge_z$ layer ($0<z<1$) which contains a carrier generating impurity and an $Si_{1-w}C_w$ layer ($0.01 \leq w<1$) which contains a carrier generating impurity higher in concentration than the $Si_{1-z}Ge_z$ layer. The semiconductor crystal is described as being applicable to a bipolar transistor or a field-effect transistor (page 1, para. 1); no teaching is provided of use of the semiconductor crystal as an framework material for a battery. The SiGeC semiconductor crystal is produced via epitaxial growth on a substrate (para. 10); para. 26 teaches epitaxial growth on a silicon substrate. As shown in Fig. 3, if $Si_{1-z}Ge_z$ layer forms the bottom layer of the SiGeC crystal, this layer contacts the Si substrate on the lower side of the layer and a $Si_{1-w}C_w$ layer on the upper side of the layer. Intermediate $Si_{1-z}Ge_z$ layers are "sandwiched" between two $Si_{1-w}C_w$ layers. If a $Si_{1-z}Ge_z$ layer forms the upper layer of the SiGeC crystal it contacts a $Si_{1-w}C_w$ layer on the lower side of the layer. The thickness of each layer is preferably 1 nm or less (para. 44, page 4).

Amended claim 1 recite that the electrode comprises a substrate and a nanostructured material, the nanostructured materials being in the form of a single layer . The nanostructured material is a silicon-germanium alloy of formula $Si_{(1-z)}Ge_z$ where z is from 0.25 to 0.75. As discussed above, Saitoh teaches combination of multiple $Si_{1-z}Ge_z$ layers with multiple $Si_{1-w}C_w$ layers. Therefore, Saitoh does not teach all the limitations of amended claim 1. Reconsideration and withdrawal of the rejection of claim 1 is respectfully requested. Claims 2-18., 43-45 and 51 depend from and incorporate all the limitations of claim 1. Applicants further note that claim 43 has been amended to specify that the conductive diluent is a metal or a conductive carbonaceous material. In view of all the foregoing, reconsideration and withdrawal of the rejections of claims 2-18, 43-45 and 51 is also requested.

Amended claim 41 specifies that the nanofilm is amorphous. As previously discussed, Saitoh discloses a $Si_{1-x-y}Ge_xC_w$ semiconductor crystal formed via epitaxial growth. Therefore Saitoh does not teach all the limitations of amended claim 41. Reconsideration and withdrawal of the rejection of claim 41 is respectfully requested. Since claims 52-56 depend from and incorporate all the limitations of claim 41, reconsideration and withdrawal of the rejections of claims 52-56 is also requested.

Amended claim 46 specifies that the nanostructured material comprises germanium or germanium alkalki metal alloy nanoparticles and a conductive diluent selected from metals and carbonaceous materials. Saitoh apparently fails to teach either germanium or germanium alkalki metal alloy nanoparticles or a conductive diluent selected from metals and carbonaceous materials. Reconsideration and withdrawal of the rejection of claim 41 is respectfully requested. Since claims 47-50 depend from and incorporate all the limitations of claim 41, reconsideration and withdrawal of the rejections of claims 47-50 is also requested.

Zhou et al.

Claims 41, 42, 46-50 and 52-62 were rejected under 35 U.S.C. 102(b) as being anticipated by WO 01/96847(hereinafter Zhou).

Amended claim 41 specifies that the nanofilm is amorphous. Zhou does not specifically teach use of amorphous nanostructures or teach any benefits through use of amorphous nanostructures. In addition, all the x-ray data provided in the application indicates crystalline nanostructures. Furthermore, the references cited by Zhou as being suitable for formation of silicon nanostructures and nanostructured germanium do not teach formation of amorphous nanostructures. Zhou teaches that a suitable technique for forming silicon nanostructures and nanostructured Ge is the laser ablation method disclosed in the reference entitled "A Laser Ablation Method for the Synthesis of **Crystalline** Semiconductor Nanowires' (Morales and Lieber, Science, 279, 209-8-211, 1998). The other reference cited by Zhou, Zhang et al., Appl. Phys. Lett, 72, 15, 1835-1837, 1998 teaches formation of crystalline silicon nanowires. (*copies of abstracts/papers attached for the Examiner's convenience for interview?*). Therefore, Zhou does not specifically teach all the limitations of claim 41 and reconsideration and withdrawal of the rejection of claim 41 is respectfully requested. Claims 52-56 depend from and incorporate all the limitations of claim 41. In addition, the Zhou reference fails to teach the additional limitations of claims 53, 54 and 56. In view of all the foregoing, reconsideration and withdrawal of the rejections of claims 52-56 is requested.

Amended claim 42 specifies that the nanofilm is amorphous prior to electrochemical alloying. As previously discussed, Zhou does not specifically teach use of amorphous nanostructures. Therefore, Zhou does not specifically teach all the limitations of claim 42 and withdrawal of the rejection of claim 42 is respectfully requested. Claims 57-62 depend from and incorporate all the limitations of claim 42. In addition, the Zhou reference fails to teach the

additional limitations of claims 58, 60 and 62. In view of all the foregoing, reconsideration and withdrawal of the rejections of claims 57-62 is requested.

Amended claim 46 specifies that the nanostructured material comprises germanium or germanium alkalki metal alloy nanoparticles and a conductive diluent selected from metals and carbonaceous materials. Zhou fails to teach use of a conductive diluent selected from metals and carbonaceous materials. Therefore, Zhou does not specifically teach all the limitations of claim 46 and reconsideration and withdrawal of the rejection of claim 46 is respectfully requested. Claims 47-50 depend from and incorporate all the limitations of claim 46. In addition, Zhou does not teach the specific structure of claim 48. In view of all the foregoing, reconsideration and withdrawal of the rejections of claims 47-50 is also requested.

<u>The Rejections Under 35 U.S.C. 103(a)</u>

<u>Sammells et al. in view of Zhou</u>

Claims 42, 46-50, 57-59, 61 and 62 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 4, 346,152 to Sammells et al (hereinafter Sammells) in view of Zhou.

The Office Action states that at the time of the invention it would have been obvious to one of ordinary skill in the art to optimize the alloy structure size of Sammells as taught by Zhou.

Amended claim 42 specifies that the nanofilm is amorphous prior to electrochemical alloying. Applicants respectfully submit that the combination of the Sammells and the Zhou references do not specifically teach this limitation. Therefore, reconsideration and withdrawal of the rejection of claim 42 is respectfully requested. Claims 57-59 and 61-62 depend from and incorporate all the limitations of claim 42. Therefore, reconsideration and withdrawal of the rejection of claims 57-59-61-62 is also requested.

Claim 46 contains the limitation that the electrode comprises a conductive diluent selected from metals and carbonaceous materials. Neither the Zhou nor the Sammells references appear to teach use of a conductive diluent in the electrode. In the absence of such teaching, Applicants respectfully submit that the combination of the Zhou and Sammells references fails to teach all the limitations of claim 46. Applicants also submit that the combination of the Zhou and Sammells references fails to teach the electrode structure of claim 48. In view of all the foregoing, Applicants respectfully request reconsideration of claim 46 and claims 47-50, which depend from claim 46.

<u>Sammells in view of Zhou and further in view of Kriesel et al.</u>

Claims 30-40 and 60 were rejected under 35 U.S.C. 103(a) as being unpatentable over Sammells in view of Zhou as applied above and further in view of U.S. Pre-Grant Publication No. 2004/0106741 hereinafter Kreisel. Applicants note that claims 30-40 have been cancelled.

The Office Action states that Sammells as modified by Zhou does not teach the specific thickness of the film, but does teach the size of the particles used in the film. The Office Action further states that the size of Zhou's particles would form a very thin nanofilm when used in a coating an asserts that it would have been obvious to one having ordinary skill in the art to optimize the thickness of the nanofilm of Sammels as modified by Zhou as taught by Kriesel. Applicants respectfully disagree, but note that the combination of the Sammells, Zhou and Kriesel references fails to teach the all the limitations of claim 60. Through its dependence from claim 42, claim 60 incorporates the limitation that the Si-Ge or Ge nanofilm is amorphous prior to electrochemical alloying. The combination of the Sammells, Zhou and Kriesel references fails to fairly teach this limitation. Therefore, reconsideration and withdrawal of the rejection of claim 60 is respectfully requested.

The New Claims

Claims 63 and 64 depend from claim 7 and claim 65 depends from claim 1. Since claims 1 and 7 are believed to be in condition for allowance, claims 63-65 are also believed to be in condition for allowance.

Conclusion

All claims being in condition for allowance, passage to issuance is respectfully requested.

Applicants hereby request that an extension of time be granted for the filing of this response. It is believed that a fee of $555, for a three months extension of time, is due with this submission. It is believed that no claims fees are due since the number of dependent claims canceled in this response exceeds the number of dependent claims added. If the amount submitted during EFS filing of this response is incorrect, please charge any deficiency or credit any overpayment to deposit account 07-1969.

Respectfully submitted.

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